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(54) **COMPACT SNUBBING UNIT**

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(51) **Int. Cl.**
E21B 19/22 (2006.01)

(52) **U.S. Cl.** **166/77.1**; 166/77.4

(58) **Field of Classification Search** 166/77.1, 166/77.2, 77.4, 75.14, 380, 381
See application file for complete search history.

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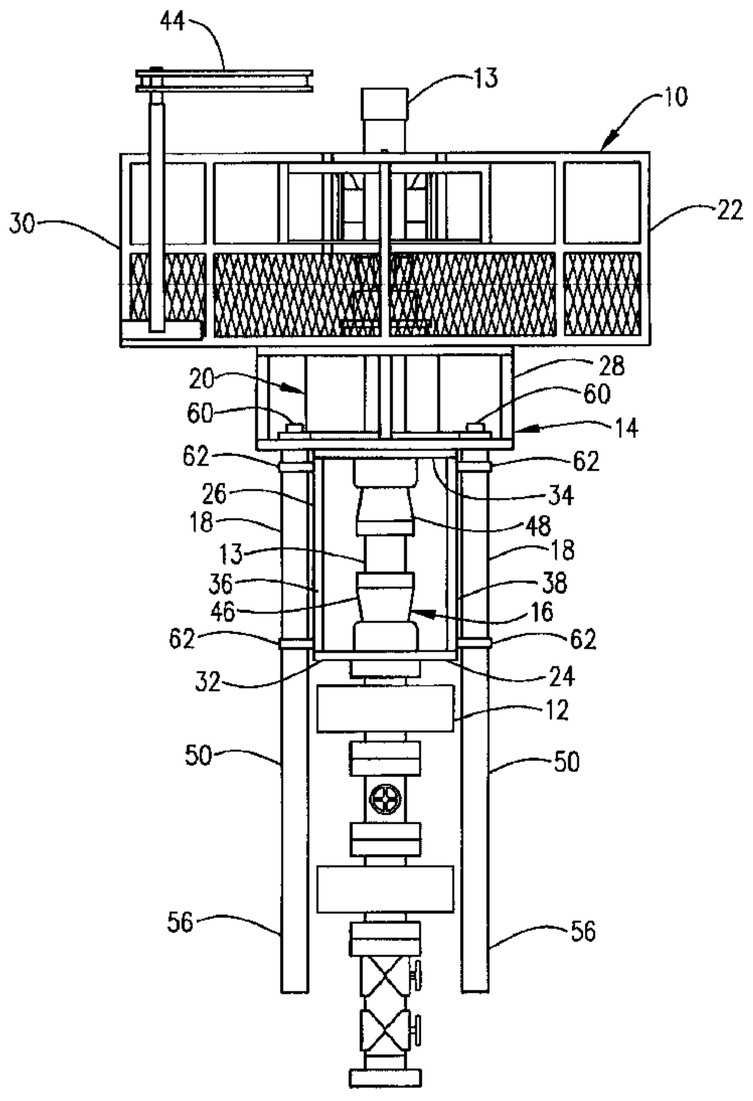
(57) **ABSTRACT**

A snubbing apparatus for moving well tubing through a blowout preventer including a support frame, a standing tubular engaging assembly, a pair of linear actuators, and a traveling tubular engaging assembly. The actuators have a cylinder and a rod, and the cylinder has an upper end and a lower end. The cylinders are connected to the support frame in a diametrically opposing relationship to one another and with the lower ends of the cylinders extending downwardly beyond the lower end of the support frame and spaced apart from one another a distance sufficient so that the lower ends of the cylinders are positioned on opposing sides of the blowout preventer when the support frame is connected to the blowout preventer.

6 Claims, 4 Drawing Sheets



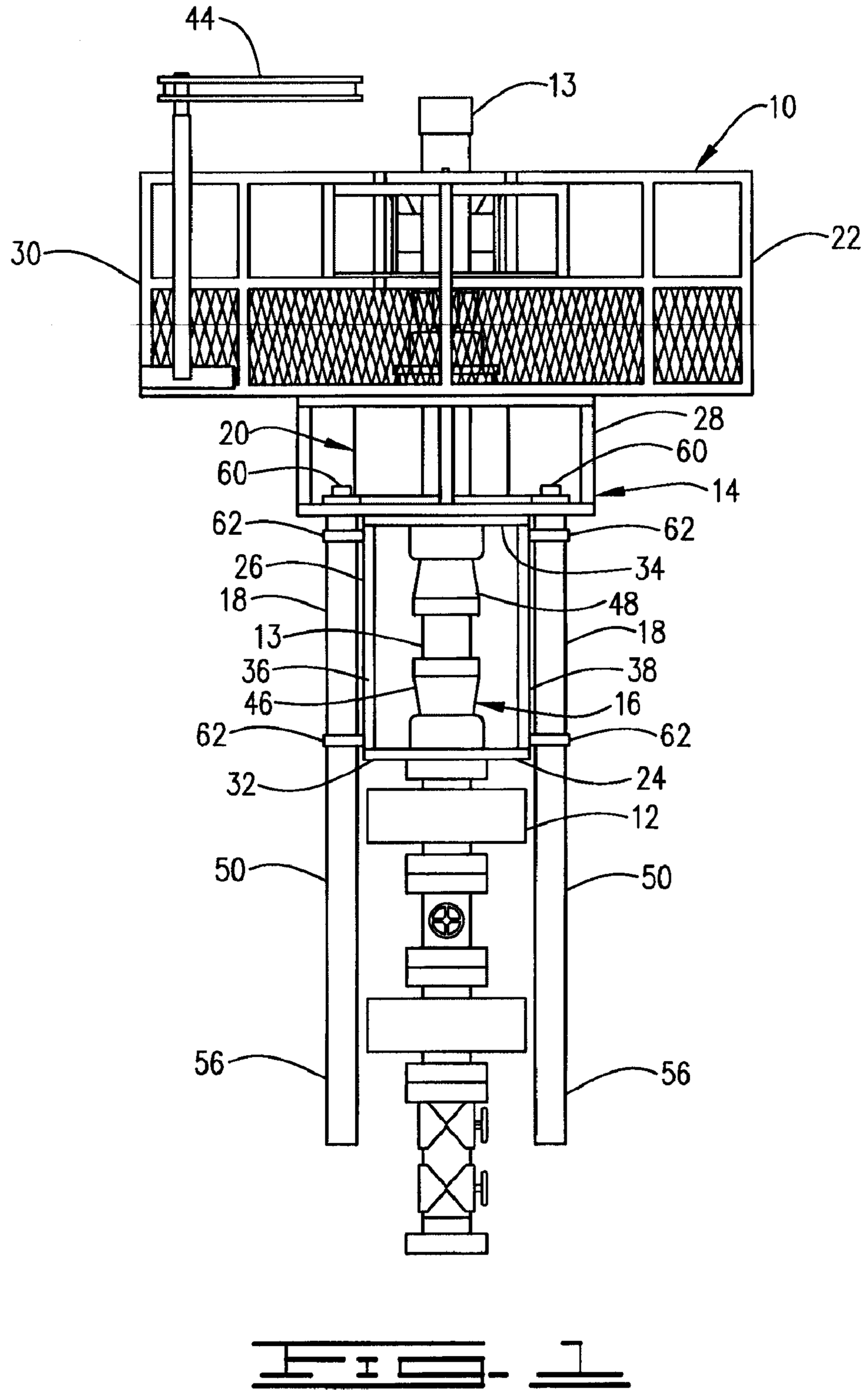

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FIG. 1

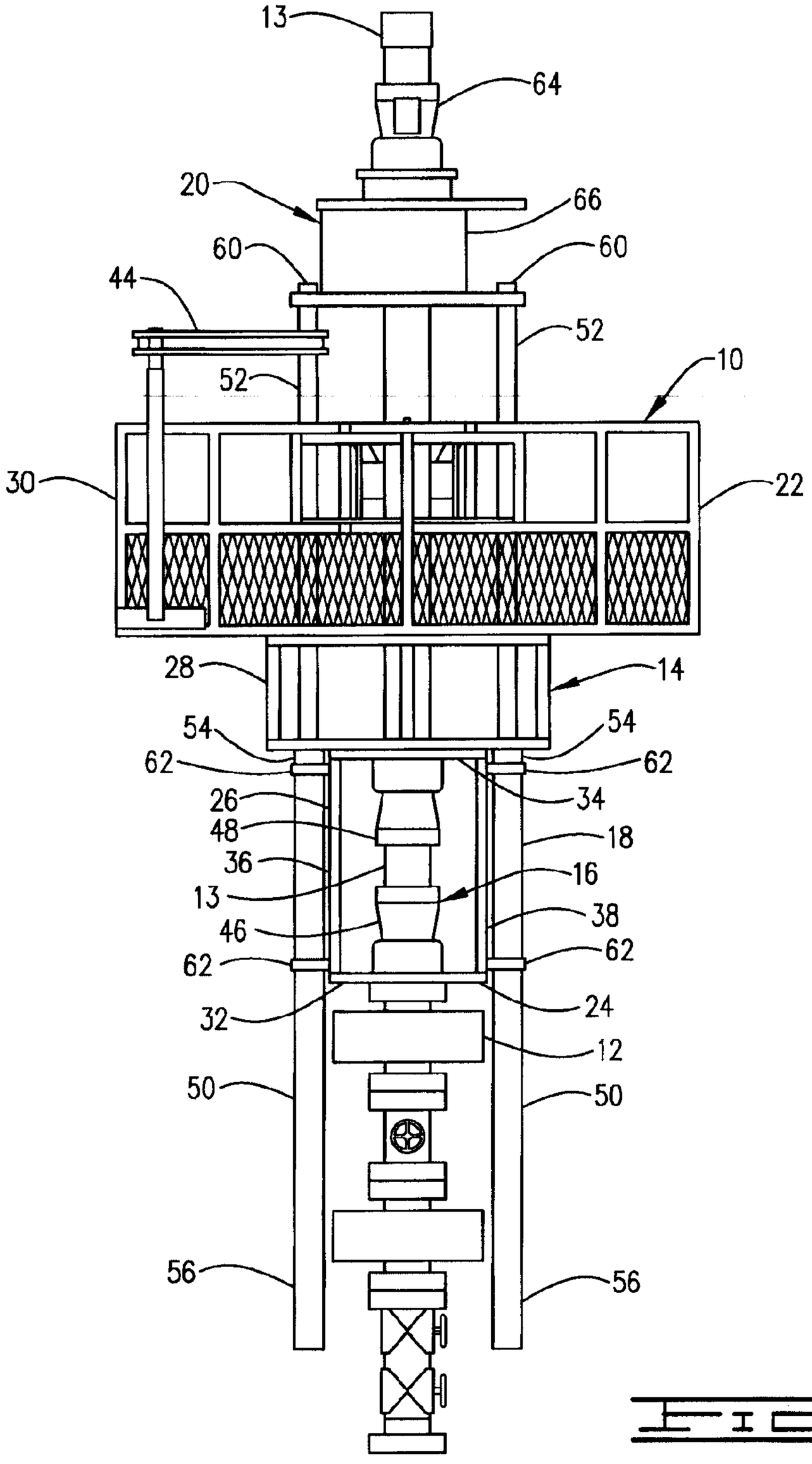
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FIG. 2

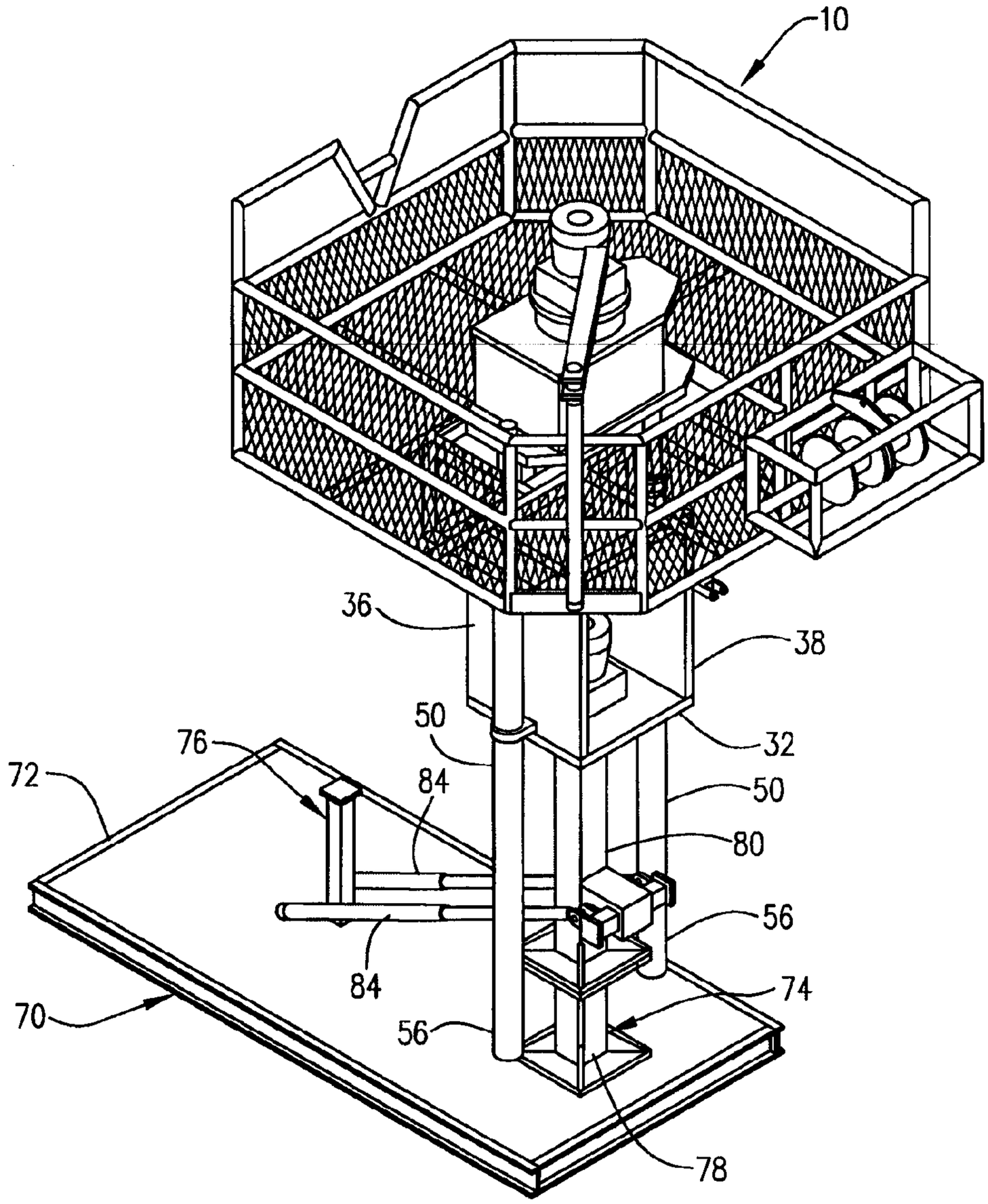

FIG. 3

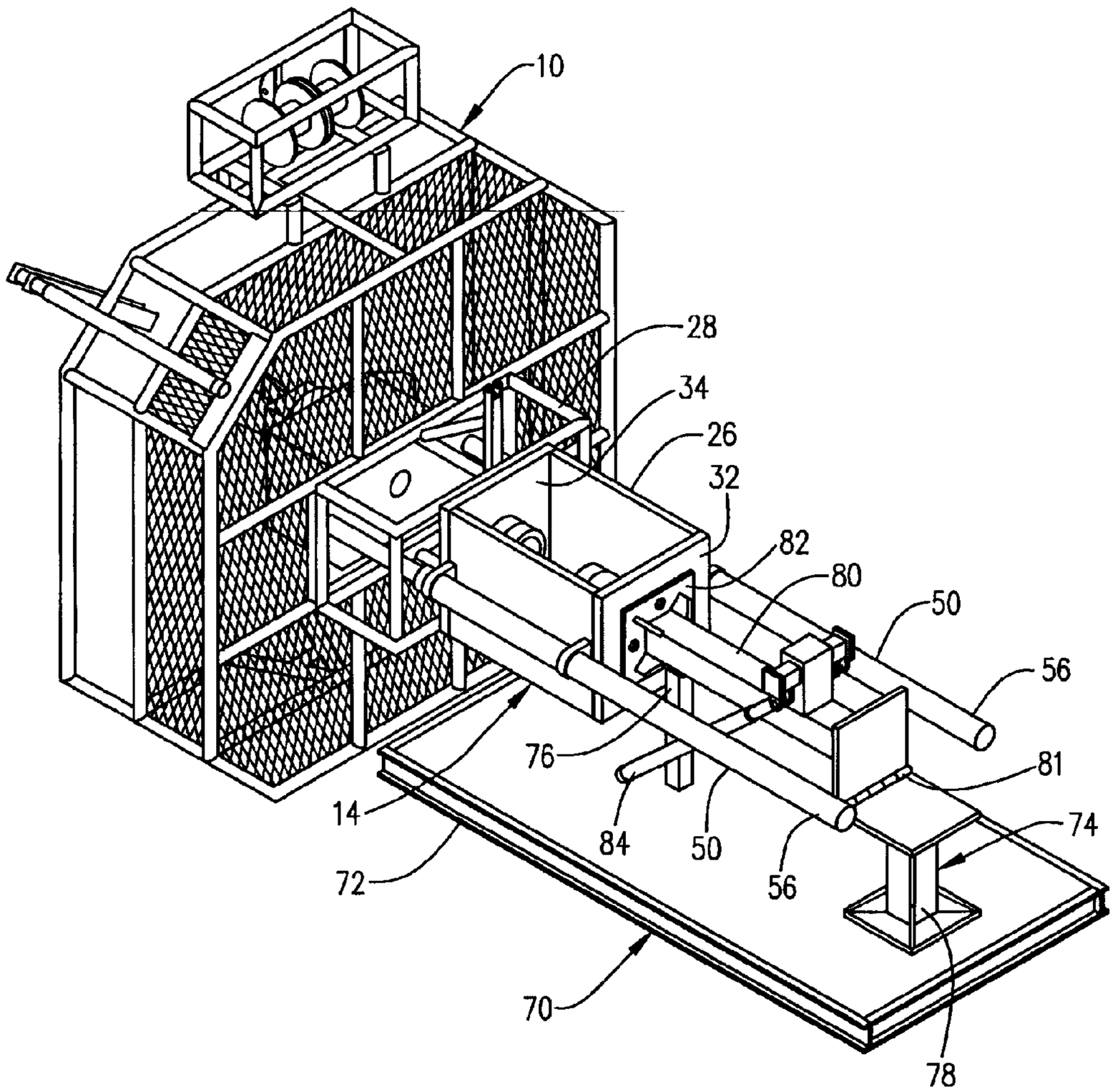

FIG. 4

COMPACT SNUBBING UNIT

CROSS REFERENCE TO RELATED APPLICATIONS

This application claims benefit to U.S. Provisional Application No. 61/157,731, filed Mar. 5, 2009, of which the entire contents are hereby incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to well tubing handling systems, and more particularly, but not by way of limitation, to a snubbing apparatus used for running and pulling well tubing through a wellhead under pressure.

2. Brief Description of Related Art

Well tubing handling systems employed in running and pulling well tubing under pressure, particularly, for well workover operations, have been known for many years. Such well tubing handling systems are commonly known as "snubbing units." It is common practice to use cable and pulley arrangements and hydraulic cylinders, both alone and in combination, for lifting well tubing from a well and for pushing the well tubing downwardly into the well against well pressure. Some such systems are mounted on and supported solely from the wellhead structures, while others involve the use of substantial platform structures, including derrick type frameworks.

An important factor in the operation of well snubbing units is the cost of servicing a well with the apparatus. Such cost is often directly related to the length of time the well is shut down and, thus, not producing an income, and the length of time the well is shut down directly corresponds to how long the snubbing operation takes. Many factors dictate how long a snubbing operation will last. One of these factors includes the depth of the well. However, other factors directly related to the snubbing apparatus include the length of its stroke and its lifting capacity. Clearly, a snubbing apparatus with a short stroke length will require a greater number of cycles to run or pull a given length of well tubing.

Another factor in the operation of well snubbing apparatus is getting the apparatus to the well site. Many wells have been drilled in environmentally sensitive areas not easily accessible by land vehicle. For example, many wells have been drilled in offshore locations or in swamp lands. Prior art snubbing apparatus are typically trailer mounted eliminating the ability to operate in offshore or swampy areas. For snubbing apparatus that might be sized to be transported by water vehicles, a downsized version may be a limiting factor with respect to the length of the stroke of the device and the amount of weight the unit can lift, thereby increasing the cost of operating such a snubbing apparatus.

To this end, a need exists for a compact snubbing apparatus that is capable of being mounted to a vehicle which is capable of accessing wet areas, such as a barge or swamp buggy, while not sacrificing power or stroke length. It is to such a snubbing apparatus that the present invention is directed.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an elevational view of a snubbing apparatus constructed in accordance with the present invention shown connected to a blowout preventer and in a retracted condition.

FIG. **2** is an elevational view of the snubbing apparatus of FIG. **1** shown in an extended condition.

FIG. **3** is a perspective view of the snubbing apparatus of the present invention shown mounted to a lay down assembly and in an up position.

FIG. **4** is a perspective view of the snubbing apparatus of FIG. **3**, shown in a down position.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

Referring now to the drawings, and more particularly to FIGS. **1** and **2**, a snubbing apparatus **10** embodying the features of the present invention is shown mounted on a well having a head provided with a blowout preventer **12**. The snubbing apparatus **10** is adapted to run and pull a string of well tubing, such as well tubing **13**, through the blowout preventer **12**. The blowout preventer **12** may be any suitable blowout preventer, such as the type that includes an internal bag arrangement which may be pressurized to close around a well tubing passing through the blowout preventer for preventing leakage along the tubing as the tubing is inserted into and pulled from a well. Preferably, the blowout preventer **12** is mounted on additional conventional ram-type blowout preventers supported on a master valve mounted on the wellhead which is secured on the upper end of the well casing, all of which are conventional wellhead and safety components which, for purposes of brevity, are not described herein.

The snubbing apparatus **10** includes a support frame **14**, a standing tubular engaging assembly **16**, a pair of actuators **18**, and a traveling tubular engaging assembly **20**. The support frame **14** is characterized as having an upper end **22** and a lower end **24** with the lower end **24** being connectable to the blowout preventer **12**. More particularly, the support frame **14** has a slip frame **26**, an auxiliary frame **28**, and a work platform or basket **30**.

The slip frame **26** generally includes a bottom plate **32**, a top plate **34**, and two side plates **36** and **38**, all interconnected with one another to form a substantially square or rectangular box structure. The bottom plate **32** and the top plate **34** are each provided with an opening (not shown) which are axially aligned with one another to receive the well tubing there through. The bottom plate **32** defines the lower end **24** of the support frame **14** and is adapted to be connected to the upper end of the blowout preventer **12** with suitable fasteners, such as nut and bolt combinations.

The auxiliary frame **28**, as best shown in FIG. **4**, is an open sided and open ended rectangular structure connected to the top plate **34** of the slip frame **26**. The auxiliary frame **28** serves to support the work platform **30** in a vertically spaced relationship above the top plate **34** of the slip frame **26**. The auxiliary frame **28** is preferably dimensioned such that the traveling tubular engaging assembly **20** is substantially received within the auxiliary frame **28** (FIG. **1**) when the actuators **18** are in a retracted position as will be described in more detail below. In addition, the auxiliary frame **28** provides access for the actuators **18** to extend from the slip frame **26** to a position above the work platform **30** in a manner also to be discussed below.

The work platform **30** is mounted on an upper end of the auxiliary frame **28** to support workers and ancillary equipment, such as a control console (not shown), a winch **44**, and a gin pole (not shown).

The standing tubular engaging assembly **16** is shown herein to include a lower slip bowl assembly **46** connected to the lower plate **32** of the slip frame **26** and an upper slip bowl assembly **48** connected to the upper plate **34** of the slip frame **26**. The lower slip bowl assembly **46** and the upper slip bowl assembly **48** may be any suitable mechanism for selectively

gripping and releasing well tubing. In general, the slip bowl assemblies will comprise an annular slip bowl having an inclined surface. A plurality of slip jaws will have a complimentary inclined surface which slides down the inclined surface allowing teeth on slip jaws to engage the well tubing. When the slip jaws are set, it will be readily apparent that the weight of the well tubular pulling the slip jaw downward will cause the slip jaw to grip the well tubular with greater axial force. To release the well tubular, its weight is removed from the slip jaws and the slip jaws are pulled from contact with the well tubular. Slip bowl assemblies as briefly described above are well known in the art. Thus, no further description of their components, construction, or operation is believed necessary in order for one skilled in the art to understand and implement the apparatus of the present invention.

The actuators **18** are shown to be conventional hydraulic piston and cylinder assemblies comprising a cylinder **50** and a rod **52**. Each of the cylinders **50** is characterized as having an upper end **54** and a lower end **56**, and the rod **52** is characterized as having a proximal end which is contained within the cylinder **50** and thus is not shown, and a distal end **60**. The rod **52** extends from the upper end **54** of the cylinder **50** and is operable between a retracted condition (FIG. **1**) and an extended condition (FIG. **2**). The actuators **18** may be any conventional hydraulic piston and cylinder assembly. Hoses and other details concerning the flow of hydraulic fluid in the cylinders are not shown because the operation of hydraulic cylinders is believed to be well known in the art. Moreover, it should be appreciated that many other types of actuator assemblies may be used in place of hydraulic cylinders, and those are intended to be included within the scope of the present invention. Further, while the cylinder and piston assemblies will generally be discussed herein as being hydraulically operated, it will be understood that pneumatic assemblies could also be employed.

The cylinders **50** are connected to the side plates **36** and **38** of the slip frame **26** in a diametrically opposed relationship to one another. To reduce the profile of the snubbing apparatus **10**, the cylinders **50** are connected to the side plates **36** and **38** such that the lower ends **56** of the cylinders **50** extend downwardly beyond the bottom plate **32** of the slip frame **26**. To this end, as shown in FIGS. **1** and **2**, the cylinders **50** are spaced apart from one another a distance sufficient so that the lower ends **56** of the cylinders **50** are positionable on opposing sides of the blowout preventer **12** when the support frame **14** is connected to the blowout preventer **12**. It will be appreciated that the distance beyond the lower plate **32** which the cylinders **50** extend may be varied, and may depend on such variables as the dimensions of the slip frame **26** and the length of the cylinders **50**. In the end, the only limiting factor with respect to how far beyond the lower plate **32** of the slip frame **26** that the cylinders may extend is that the lower end **56** of the cylinders should be spaced above the ground support surface to permit the snubbing apparatus **10** to be erected in a substantially vertical orientation. The cylinders **50** are connected to the side plates **36** and **38** with connectors **62**. The connectors **62** may be any suitable connector for securing the cylinders **50** to the side plates **36** and **38**; however, it is preferable that the connectors **62** be detachable from the side plates **36** and **38** such that the cylinders **50** may be detached from the side plates **36** and **38** to allow for the actuators **18** to be removed and replaced with actuators of a different size, as desired.

The traveling tubular engaging assembly **20** is connected to the distal end **60** of the rods **52** and is operable between a tubular engaging condition and a tubular release condition. In general, the traveling tubular engaging assembly **20** includes a slip bowl assembly **64** connected to a rotary table **66**. Like the upper and lower slip bowl assemblies **46** and **48** described above, the slip bowl assembly **64** and the rotary table **66** are well known in the art. Thus, no further description of their components, construction, or operation is believed necessary in order for one skilled in the art to understand and implement the apparatus of the present invention.

In use, the snubbing apparatus **10** is connected to the blowout preventer **12** such that the lower ends **54** of the cylinders **50** are positioned on opposing sides of the blowout preventer **12**. It will be appreciated that the snubbing apparatus **10** is positioned on the blowout preventer **12** with a suitable device, such as a crane (not shown) which would be provided at the well site. To run well tubing, such as well tubing **13**, into the well, each length of tubing is raised to a position above the standing tubular engaging assembly **16** and lowered downwardly through the slip bowl assembly **64** and the rotary table **66**. The actuators **18** are extended thereby raising the traveling tubular engaging assembly **16** to grip the tubing **13** (FIG. **2**) near its upper end thereof. The traveling tubular engaging assembly **20** is then lowered by retracting the rods **52** so as to force the tubing **13** downwardly through the upper slip bowl assembly **48**, the lower slip bowl assembly **46**, through the blowout preventer **12** into the wellbore. When the actuators **18** are fully retracted, one of the upper slip bowl assembly **48** and the lower slip bowl assembly **46** is activated to grip the tubing **13** to hold the tubing either against the weight of gravity or against the well pressure depending upon operating conditions while the traveling tubular engaging assembly **20** is released from the tubing **13** and raised to grip and force another increment of the tubing string downwardly. The length of each increment of tubing depends upon the amount of extension provided in the actuators. A plurality of lengths of tubing are connected in a conventional manner as the tubing string is made up and forced downwardly by the snubbing apparatus **10**.

In pulling a tubing string from a wellbore, the tubing string is sequentially engaged by the traveling tubular engaging assembly **20** when the actuators **18** are in a retracted position and the traveling tubular engaging assembly **20** is then raised by the actuators **18** to lift the tubing string. During the retracted cycle of the actuators, the appropriate lower and upper slip bowl assemblies **46** and **48** are engaged with the tubing to hold it while the traveling tubular engaging assembly **20** moves from the extended position to a retracted position to re-engage and lift the tubing string.

Referring now to FIGS. **3** and **4**, the snubbing apparatus **10** further includes a laydown assembly **70**. The laydown assembly **70** serves to transport the portion of the snubbing apparatus **10** previously described. The laydown assembly **70** includes a skid or base platform **72**, a first pedestal assembly **74**, and a second pedestal assembly **76**. The base platform **72** is generally a skid with an upper surface capable of supporting the snubbing apparatus **10**.

The first pedestal assembly **74** includes a first rigid portion **78** connected to the base platform **72** and extending upwardly therefrom. The first pedestal assembly **74** further includes a second rigid portion **80** which is pivotally connected to the first rigid portion with a hinge **81** (FIG. **4**). The second rigid portion **80** has an upper flanged end **82** (FIG. **4**) that is connectable to the lower plate **32** of the slip frame **26** when the snubbing apparatus **10** is disconnected from the blowout preventer **12**. The first rigid portion **78** and the second rigid portion **80** have a combined length such that the lower ends **56** of the cylinders **50** are vertically spaced from the base plat-

form **72** when the lower plate **32** of the support frame **14** is connected to the flanged upper end of the second rigid portion **80**.

The second rigid portion **80** is moveable between a first or up position (FIG. **3**) wherein the second rigid portion **80** is axially aligned with the first rigid portion **78** and a second or down position (FIG. **4**) wherein the second rigid portion **80** is angularly positioned relative to the first rigid portion **78**. The laydown assembly **70** further includes a pair of actuators **84** for moving the second rigid portion **80**, along with the snubbing apparatus **10**, between the first position and the second position. The actuators **84** are pivotally connected at one end to the base platform **72** and pivotally connected at the other end to the second rigid portion **80** of the first pedestal assembly **74**.

The second pedestal assembly **76** is connected to the base platform **72** and is positioned to engage and support the second rigid portion **78** when the second rigid portion **80** is in the second position, as shown in FIG. **4**.

It will be appreciated by those of ordinary skill in the art that the snubbing apparatus **10** described herein will generally be hydraulically operated. To this end, the snubbing apparatus **10** will require hydraulic power and control fluids system for operating the snubbing apparatus **10**. Hydraulic power and control systems are well known in the art. Thus, no further description of their components, construction, or operation is believed necessary in order for one skilled in the art to understand and implement the apparatus of the present invention.

From the above description, it is clear that the present inventive concept is well adapted to carry out the objects and to attain the advantages mentioned herein as well as those inherent in the invention. While a presently preferred embodiment of the invention have been described for purposes of this disclosure, it will be understood that numerous changes may be made which will readily suggest themselves to those skilled in the art and which are accomplished within the spirit of the invention disclosed and as defined in the appended claims.

What is claimed is:

1. A snubbing apparatus for moving well tubing through a blowout preventer, comprising:

a support frame having an upper end and a lower end, the lower end being connectable to the blowout preventer;

at least one standing tubular engaging assembly connected to the support frame, the standing tubular engaging assembly being operable between a tubular engaging condition and a tubular release condition;

at least two linear actuators, each actuator having a cylinder and a rod, the cylinder having an upper end and a lower end, and the rod having a proximal end and a distal end, the rod extending from the upper end of the cylinder and being operable between a retracted condition and an extended condition, the cylinders connected to the support frame in a diametrically opposing relationship to one another and with the lower ends of the cylinders extending downwardly beyond the lower end of the support frame and spaced apart from one another a distance sufficient so that the lower ends of the cylinders are positioned on opposing sides of the blowout preventer when the support frame is connected to the blowout preventer; and

a traveling tubular engaging assembly connected to the distal end of the rods, the traveling tubular engaging assembly being operable between a tubular engaging condition and a tubular release condition,

wherein the support frame further comprises a slip frame including a bottom plate, a top plate, and at least two side plates, the bottom plate and the top plate each having an opening axially aligned with the other opening to receive the well tubing therethrough, the bottom plate defining the lower end of the support frame, the standing tubular engaging assembly being connected to at least one of the bottom plate and the top plate and about the opening of the respective top and bottom plate.

2. The snubbing apparatus of claim **1**, wherein the standing tubular engaging assembly includes a first slip bowl assembly connected to the bottom plate and a second slip bowl assembly connected to the top plate in an opposing relationship.

3. The snubbing apparatus of claim **1** wherein the cylinders are connected to the side plates of the slip frame.

4. The snubbing apparatus of claim **1** wherein the support frame further comprises a work platform vertically spaced above the upper plate of the slip frame, the work platform being spaced from the top plate a distance such that the traveling tubular engaging assembly is substantially received between the top plate and the work platform when the rods are in the retracted position.

5. The snubbing apparatus of claim **1** further comprising:

a laydown assembly comprising:

a base platform;

a pedestal assembly having a first rigid portion connected to the platform and extending upwardly therefrom and a second rigid portion pivotally connected to the first portion, the second rigid portion having an upper end connectable to the lower end of the support frame when the support frame is disconnected from the blowout preventer, the first rigid portion and the second rigid portion having a combined length such that the lower ends of the cylinders are vertically spaced from the base platform when the lower end of the support frame is connected to the upper end of the second rigid portion, the second rigid portion being movable between a first position wherein the second rigid portion is axially aligned with the first rigid portion and the support frame is in a substantially vertical orientation and a second position wherein the second rigid portion is angularly positioned relative to the first rigid portion and the support frame is in a substantially prone position; and

means for moving the second rigid portion between the first position and the second position.

6. The snubbing apparatus of claim **5** wherein the laydown assembly further comprises a second pedestal assembly connected to the base platform and positioned to engage the second rigid portion when the second rigid portion is in the second position.

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